

## 3.0 Technology Applications Analysis

This section describes the Envirobond™ technology. It identifies the waste to which the technology is applicable and discusses the method of application used during the demonstration, materials handling requirements, the limitations of the technology, potential regulatory requirements, key features, the availability and transportability of the technology, and acceptance of the technology by state regulators and communities.

### 3.1 Description of the Technology

The Envirobond™ process incorporates the application of a mixture of a proprietary powder and liquid that binds with metals in contaminated solid media. The Envirobond™ reagents (liquid and powder) consist of a mixture of additives containing oxygen, sulfur, nitrogen, and phosphorous; each additive has an affinity for a specific class of metals. RMRS claims that the Envirobond™ process converts the metal contaminant from its leachable form to an insoluble, stable, nonhazardous organo-metallic complex. The Envirobond™ reagents are essentially a mixture of ligands that act as chelating agents. In the chelation reaction, coordinate bonds attach the metal ion to at least two ligand nonmetal ions to form a heterocyclic ring. RMRS claims that, by effectively binding the metals, the Envirobond™ process reduces the waste stream's TCLP test results to less than regulated levels, thereby reducing the risks posed to human health and the environment (RMRS, 1999). The Envirobond™ process generates no secondary wastes and requires minimal handling, transportation, and disposal costs.

### 3.2 Applicable Wastes

RMRS claims that the Envirobond™ process can treat heavy metals in soils, sludges, mine tailings and process residues, and other solid waste. RMRS states the following heavy metals can be stabilized with the Envirobond™ process: arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and zinc (RMRS 1999). According to RMRS, the Envirobond™ process can also stabilize wastes contaminated with various radionuclides, including thorium, uranium, radium, and cesium.

### 3.3 Method of Application

The Envirobond™ process is applied *in situ* using common farm and construction equipment at large sites, and with simple gardening equipment for smaller treatment areas. For example, the Envirobond™ powder was applied to the surface of the tilled experimental units at the CRPAC demonstration site with a fertilizer drop spreader. The Envirobond™ liquid was applied over the powder using a

watering can. The mixture was then tilled into the soil using a garden tiller. If necessary, flyash can be used to adjust the pH of a treatment plot after the application of the Envirobond™ process. The flyash is spread over the surface of the plot and tilled into the soil.

RMRS determines an appropriate, site-specific concentration of the Envirobond™ powder and liquid to be applied by determining the density, volume, weight, and amount of contamination present in the soil through bench-scale studies on soil samples. An evaluation of the soil chemistry at the site must be performed to determine the contaminant concentration throughout the site and the concentration of other metals that may be present at the site. Site conditions such as soil type, depth of contamination, and moisture content must be evaluated to determine the application procedure and equipment requirements.

The site should be accessible to wheeled or tracked vehicles and have sufficient storage space for the equipment required to apply the Envirobond™ process to a specific site. No utilities are required for the application of the Envirobond™ process. Potable water is required for equipment and personnel decontamination.

### 3.4 Material Handling Requirements

The Envirobond™ powder and liquid are both nonhazardous and require no special handling procedures. To decrease the variability of lead in the soil at the CRPAC, the contaminated soil was tilled to a depth of 6 inches. The soil must be kept moist to prevent airborne transmission of the metals in the soil. Once the soil has been tilled, the Envirobond™ process can be applied. After the application of the Envirobond™ mixture, the soil was tilled again to mix these components into the soil, depending on the soil conditions. Following the soil treatment, all field equipment and personal protection equipment (PPE) must be decontaminated. For the CRPAC demonstration, this was accomplished with soap, water, and Alconox™ detergent, followed by a deionized water rinse. While the Envirobond™ process is expected to generate little residual waste, any soil on the equipment, fluids used in the decontamination process, disposable PPE, and possibly the sod removed from the treatment plot, should be treated as a potentially hazardous waste. This waste should be containerized and characterized for proper disposal.

### 3.5 Limitations of the Technology

The presence of metals such as aluminum, magnesium, calcium, and manganese at concentrations more than 30

percent by weight can reduce the bonding capability of the Envirobond™ process. RMRS reports that the Envirobond™ process is not effective in treating soil with lead concentrations greater than 30 percent by weight.

### 3.6 Potential Regulatory Requirements

This section discusses environmental regulations that may pertain to the application of Envirobond™. The applicability of regulations to a particular remediation activity depends on the type of remediation site and the type of waste treated. Remedial managers also must address state and local regulations, which may be more stringent. ARARs for applications of Envirobond™, although site-specific, may include the requirements of following federal regulatory programs: (1) the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); (2) RCRA; (3) OSHA; and (4) the Clean Water Act (CWA).

#### 3.6.1 CERCLA

CERCLA, as amended by the SARA, provides for federal authority and funding to respond to releases or potential releases of any hazardous substance into the environment, as well as to releases of pollutants or contaminants that may present an imminent or significant danger to public health and welfare or to the environment. CERCLA is pertinent to a consideration of Envirobond™ because it governs the selection and application of remedial technologies at Superfund sites.

In general, two types of responses are possible under CERCLA: removal action and remedial action. Remedial actions are governed by the SARA amendments to CERCLA. SARA states a strong regulatory preference for innovative technologies that provide long-term protection and directs EPA to:

- Use remedial alternatives that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants
- Select remedial actions that protect human health and the environment, are cost-effective, and involve permanent solutions and alternative treatment or resource recovery technologies to the maximum extent possible
- Avoid off-site transport and disposal of untreated hazardous substances or contaminated materials when practicable treatment technologies exist [Section 121(b)]

SARA requires that on-site remedial actions comply with federal and more stringent state and local ARARs. ARARs are determined on a site-by-site basis and may be waived under any of six conditions: (1) the action is an interim measure, and the ARAR will be met at completion; (2) compliance with the ARAR would pose a greater risk to health and the environment than noncompliance; (3) it is technically impracticable to meet the ARAR; (4) the standard of performance of an ARAR can be met by an equivalent method; (5) a state ARAR has not been applied consistently elsewhere; or (6) compliance with the ARAR

would not provide a balance between the protection achieved at a particular site and demands on Superfund for addressing other sites. The waiver options apply only to Superfund actions taken on site, and justification for the waiver must be demonstrated clearly (EPA 1988).

#### 3.6.2 RCRA

RCRA, as amended by HSWA, regulates management and disposal of municipal and industrial solid wastes. EPA and the states implement and enforce RCRA and state regulations. Some of the RCRA Subtitle C (hazardous waste) requirements under 40 CFR parts 254 and 265 may apply at CERCLA sites because remedial actions generally involve treatment, storage, or disposal of hazardous waste. However, requirements under RCRA may be waived for CERCLA remediation sites, provided equivalent or more stringent ARARs are met.

RCRA regulations define hazardous wastes and regulate their transportation, treatment, storage, and disposal. The regulations are applicable to uses of Envirobond™ only if hazardous wastes as defined under RCRA are present. If soils are determined to be hazardous under RCRA (either because of a characteristic identified in RCRA or listing of the waste, the remedial manager must address all RCRA requirements governing the management and disposal of hazardous waste. Criteria for identifying characteristic hazardous wastes are set forth in 40 CFR part 261 subpart C. Listed wastes from specific and nonspecific industrial sources, off-specification products, cleanups of spills, and other industrial sources are itemized 40 CFR part 261 subpart D.

Residual wastes generated during the application of Envirobond™ must be stored and disposed of properly. If the treated waste is a listed waste, residues of treatment must be considered listed wastes (unless delisting requirements under RCRA are met). If the residues are not listed wastes, they should be tested to determine whether they are characteristic hazardous wastes as defined under RCRA. If the residues are not hazardous and do not contain free liquids, they can be disposed of in a Subtitle D facility. If the residues are hazardous, the following RCRA standards apply:

- Standards and requirements for generators of hazardous waste, including hazardous treatment residues, are set forth at 40 CFR part 262. The requirements include obtaining an EPA identification number, meeting waste accumulation standards, labeling wastes, and keeping appropriate records. Part 262 allows generators to store wastes for as much as 90 days without a permit. If residues of treatment are stored on site for 90 days or more, requirements set forth at 40 CFR part 265 are applicable.
- Any on- or off-site facility designated for permanent disposal of residues of hazardous treatment must be in compliance with RCRA. Disposal facilities must fulfill the permitting, storage, maintenance, and closure requirements at 40 CFR parts 264 through 270.

In addition, any authorized state RCRA requirements must be fulfilled. If treatment residues are disposed of off site, transportation standards set forth at 40 CFR part 263 are applicable.

### **3.6.3 OSHA**

OSHA regulations at 29 CFR parts 1900 through 1926 are designed to protect the health and safety of workers. Corrective actions undertaken under both Superfund and RCRA must meet OSHA requirements, particularly those set forth at Section 1910.120, Hazardous Waste Operations and Emergency Response. Any more stringent state or local requirements must also be met. In addition, health and safety plans for site remediation projects should address chemicals of concern and include monitoring practices to ensure that the health and safety of workers are protected.

PPE must be worn to protect field personnel from known or suspected physical hazards, as well as air-, soil-, and water-borne contamination. The levels of PPE to be used for work tasks must be selected on a site-specific basis. The level of PPE should be based on known or anticipated physical hazards and concentrations of contaminants that may be encountered at a particular site and their chemical properties, toxicity, exposure routes, and contaminant matrices. Personnel must wear PPE when site activities involve known or suspected atmospheric contamination; when site activities might generate vapors, gases, or particulates; or when direct contact with substances that affect the skin may occur. Full-face respirators may be necessary to protect lungs, the gastrointestinal tract, and eyes against airborne contaminants. Chemical-resistant clothing may be needed at certain sites to protect the skin from contact with chemicals that are absorbed through or destructive to the skin.

The information provided by RMRS and the results of observations made during the demonstration project indicate that the contaminants being treated usually are the determining factor in the selection of PPE for applications of Envirobond™. In general, latex or nitrile gloves, Tyvek coveralls, boot covers, and goggles are recommended for applying Envirobond™ to contaminated soils.

### **3.6.4 CWA**

The CWA is designed to restore and maintain the chemical, physical, and biological quality of navigable surface waters by establishing federal, state, and local discharge standards. The CWA may affect application of the technology because it governs the appropriate manner of managing water used for decontamination activities. Depending on the concentrations of the contaminants in the wastewater and any permit requirements, contaminated water from the decontamination procedures could be discharged to a publicly owned treatment works (POTW). Each POTW has a different limit for lead that is specified in the POTW's National Pollutant Discharge Elimination System (NPDES) permit. The POTW will require disclosure of the contents of the wastewater and will determine whether contaminants will interfere with the treatment of the wastewater.

### **3.7 Availability and Transportability of the Technology**

The Envirobond™ process is available from Rocky Mountain Remediation Services of Golden, Colorado, (see Section 1.4 for address and telephone number). The proprietary powder and liquid are completely nonhazardous and were transported to the CRPAC demonstration site by a medium-duty truck, which did not require any special permits or licensing to transport the material. According to RMRS, there are no restrictions on other methods of transporting the materials. All typical equipment required for the application of the Envirobond™ process are generally readily available from local rental companies and do not need to be obtained from RMRS.

### **3.8 Community Acceptance by the State and the Community**

State and community acceptance of Envirobond™ on the part of state regulatory agencies and affected communities likely will be site-specific. Because no community outreach program has been established for the CRPAC, it is difficult to predict how communities in the vicinity of the CRPAC will accept Envirobond™.